

## CATALYTIC HYDROGENATION RETROFIT REACTOR

### BENEFITS

- Improved yield
- Decreased operational costs
- Electricity savings of 11 percent and natural gas savings of 12 percent per installed unit over competitive batch technology

### APPLICATIONS

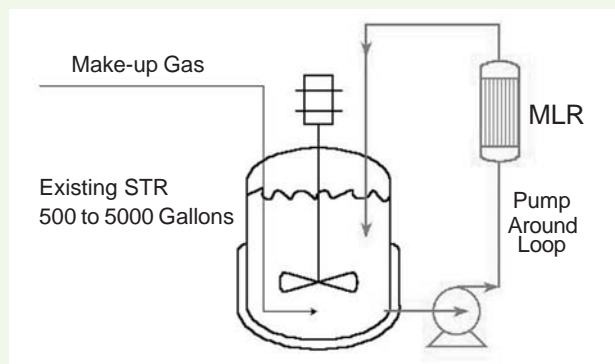
This reactor retrofit will replace slurry catalyst use in industrial hydrogenation reaction systems. Sectors of the chemical industry that use hydrogenation reactions include specialty and fine chemicals, pharmaceuticals, and agricultural intermediates. The technology could also be expanded to other sectors of the industry, such as those that produce fats and oils.

## NEW FIXED-BED CATALYST SYSTEM SIGNIFICANTLY REDUCES ENERGY USE AND HAZARD EXPOSURE

Currently, most catalytic hydrogenation processes used by fine and specialty chemical manufacturers employ slurry catalysts and use large tanks with stirring mechanisms. These existing processes can cause problems such as contamination of the environment with metals, excessive waste production, decreased plant productivity, industrial hygiene issues, and process safety concerns. Fine-powder catalysts are typically mixed with a solvent to form a slurry which attracts other raw materials in the reaction vessel. The powdered catalysts, which contain noble and heavy metals, are often pyrophoric (can spontaneously ignite upon exposure to air) and are potentially hazardous to handle. Once the chemicals in the tank are hydrogenated (the catalytic addition of hydrogen), the finished product is removed and separated from the slurry catalyst. Operators must then reprocess the spent catalyst. Spent catalysts are often filtered to remove excess solvent, then dried to return them to a solid. Special precautions must be taken during these catalyst removal and disposal processes to maintain safe and hygienic conditions for the workers, who perform many of the steps manually.

A fixed-bed, structured catalyst system can be retrofitted into existing stirred-tank reactor systems to increase reaction rates and avoid the use of slurry catalyst. This system eliminates all slurry catalyst handling and filtration, reducing or eliminating the associated environmental and safety problems. The fixed-bed monolith loop reactor (MLR) developed in this project has the potential to save 12 percent in process energy use, greatly reduce hazardous wastes, and provide significant cost savings over traditional slurry-catalyst reactors.

### MONOLITH LOOP REACTOR (MLR)



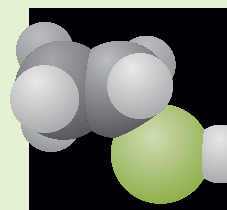
The MLR technology can be easily retrofitted to existing plant reactors to replace slurry catalysts. This flexible design can be adapted to a range of hydrogenation processes and chemistries.



## Project Summary

The unique and economical process solution developed in this project brings the advantages of fixed-bed catalytic processes to smaller-scale chemical producers. A reusable, high-activity, monolith catalyst bed provides reaction rates 10 to 100 times greater than typical reaction rates in slurry-tank reactors. The MLR technology is an integrated monolith catalyst reactor system that can easily be retrofitted into existing commercial slurry catalyst systems with stirred-tank reactors. This technology provides numerous improvements in safety, process economics, post-processing options, and control over catalyst contact in the batch cycle. The elimination of slurry catalysts and filtration unit operations can increase productivity.

In November of 2002, project partners Air Products and Johnson Matthey announced a marketing agreement to commercialize the MLR technology. Initial marketing efforts will focus on companies that operate hydrogenation reactors using precious metal catalysts. Suitable MLR systems will then be engineered on a case-by-case basis. The companies stand ready to work with manufacturers to design suitable retrofit systems for specific applications.



### PROJECT PARTNERS

Air Products and Chemicals, Inc.  
Allentown, PA

Johnson Matthey  
Wayne, PA

### FOR ADDITIONAL INFORMATION, PLEASE CONTACT:

Brian Valentine  
Office of Industrial Technologies  
Phone: (202) 586-7543  
Fax: (202) 586-1658  
E-mail: [brian.valentine@ee.doe.gov](mailto:brian.valentine@ee.doe.gov)

Reinaldo M. Machado  
Air Products and Chemicals, Inc.  
Phone: (610) 481-3539  
Fax: (610) 481-2576  
E-mail: [machadrm@apci.com](mailto:machadrm@apci.com)

Please send any comments, questions,  
or suggestions to  
[webmaster.eren@nrel.gov](mailto:webmaster.eren@nrel.gov)

Office of Industrial Technologies  
Energy Efficiency and  
Renewable Energy  
U.S. Department of Energy  
Washington, D.C. 20585



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